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(54) Drive system for an electrically operated remote control rearview mirror.

(57) A drive system for the remote control of a vehicle rearview mirror mounted to pivot about a base provides adjustment by axial movement of non-rotatable screws (14) through nuts (28) each housed in a pinion gear (26) rotatably driven by a worm gear on the output shaft of an electric motor.

The nut (28) has a spherical exterior surface (36) engaged in a spherical socket (34) formed in the bore of the pinion gear (26) to allow angular misalignment between the pinion gear axis and the nut axis. Rotary drive is transmitted from the pinion gear (26) to the nut (28) by splines on the interior of the pinion gear (26) which engage in slots on the spherical surface of the nut (28).

The screw shafts (14) have resiliently deflectable wall portions (56) carrying external thread segments (58) for engagement in the nut (28). In the event of overload or manual adjustment the wall portions (56) deflect inwardly and allow disengagement of the threads.

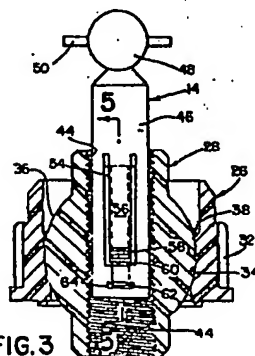


FIG. 3

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DESCRIPTIONDRIVE SYSTEM FOR AN ELECTRICALLY OPERATED  
REMOTE CONTROL REARVIEW MIRROR.

5 The present invention relates to a drive system  
for use in adjusting the position of a remotely  
controlled electrically operated automotive rearview  
mirror.

10 It is known in the prior art to adjust the  
position of an outside rearview mirror by means of  
electrically driven rotatable nuts which cause  
longitudinal non-rotary movement of two screws which  
engage the mirror backing plate to cause it to pivot  
about each of two mutually perpendicular axes. The  
rotatable nuts may be driven by either a single  
15 motor-driven worm gear which selectively pivots into  
engagement with one or the other of the nuts or by two  
sets of motors and worm gears.

Representative of such prior art patents are U.S.  
Patent numbers 3,972,597; 4,041,793; 4,273,417 and  
20 4,324,454.

It is also known to provide an override feature by  
which the motor is permitted to continue to run after  
the mirror has reached the limit of its movement, or  
conversely, to permit the mirror to be manually  
25 shifted when the motor is not operating. Such an  
override feature has been achieved, for example, by  
the use of a split nut which permits the nut to rotate  
without causing longitudinal movement of the screw or  
permits the screw to move longitudinally without  
30 rotation of the nut. The segments of the split nut  
are resiliently biased in a radially inward direction  
to normally maintain a driving engagement with the  
threads of the screw. However, in an overload  
condition, the nut segments resiliently yield radially  
35 outwardly to disengage the driving relationship

between the screw and nut threads. Exemplary of such a split nut is the drive system found in the aforementioned U.S. patent 4,041,793.

5 The present invention is directed to the creation of an alternative and improved override construction and to the provision of a screw and nut drive system which operates smoothly and uniformly irrespective of the angle of the mirror and the degree of travel of the mirror along its arc of pivotal movement.

10 According to the present invention there is provided a drive system for use in a remote control system for a vehicle mirror mounted for pivotal movement relative to a base, comprising electric motor means secured to the base and having a worm gear on  
15 its output shaft which engages an externally threaded pinion gear rotatably mounted on the base, and wherein the pinion gear is also provided with internal threads to serve as a nut, the rotation of which by the worm gear causes a non-rotatable mirror-engaging screw  
20 shaft in threaded engagement with the internal threads of the nut, to move axially to reposition the mirror, characterised in that the pinion and nut are formed as two separate but concentrically connected elements, the first of said elements being in the form of an  
25 annulus having external pinion gear teeth adapted to be rotatably driven about a first axis by the motor-driven worm gear, said annulus having a spherical socket surface on the interior of the annulus, the second of said elements being in the form  
30 of a second annulus having a ball-shaped surface on its exterior circumference dimensioned to be snugly but rotatably received in and retained by said spherical socket surface, and said second element having internal threads on the interior of said second  
35 annulus for driving engagement with a screw shaft,

driving formations on said first and second elements for causing the rotation of said first element by the worm gear to produce concurrent rotation of said second element about said first axis, said spherical surfaces and said driving formations permitting relative pivotal movement between said first and second elements about the two mutually perpendicular axes which are perpendicular to said first axis; whereby, in use, actuation of the motor produces mirror position-adjusting longitudinal movement of the screw shaft, while said spherical surfaces permit the axis of the screw shaft to pivot in response to movement of the screw shaft-to-mirror engagement point transverse to the screw shaft axis in response to pivotal movement of the mirror.

In a preferred embodiment of the present invention the worm gear-driven pinion gear has a spherical socket which receives a ball-shaped drive nut splined for co-axial rotation with the pinion gear, and internally threaded to receive a screw member having radially inwardly and resiliently yieldable male thread segments. The ball-socket relationship of the pinion gear and nut permit the axis of the nut, and therefore the axis of the screw, to pivot or skew relative to the fixed axis of the pinion gear, while the splined connection between the spherically socketed bore of the pinion gear and the ball-shaped exterior of the nut permit uniform simultaneous rotation of such members whether their axes are coaxial or skewed. This feature permits the connection of the screw to the mirror to follow the arcuate travel of the mirror as its position is adjusted by the screws, with a smooth and uniform driving relationship irrespective of the angle of the mirror.

According to a further feature of the present invention there is provided a drive system for use in a remote control system for a vehicle mirror mounted for pivotal movement relative to a base, comprising

5 electric motor means secured to the base and having a worm gear on its output shaft which engages an externally threaded pinion gear rotatably mounted on the base, and wherein the pinion gear is also provided with internal threads to serve as a nut, the rotation

10 of which by the worm gear causes a non-rotatable-engaging screw shaft in threaded engagement with the internal threads of the nut to move axially to reposition the mirror, characterised in that the screw shaft has a longitudinal bore for at least a portion

15 of its length thereby to create a tubular shaft wall, a portion of said tubular wall being partially detached from the main body thereof so as to be capable of resiliently yielding radially inwardly into said shaft bore, the radially outer face of said

20 resilient portion being provided with a segment of a screw thread, which, in the normal position of said resilient portion, projects radially outwardly from the outer surface of said tubular wall for driving engagement with the internal threads of the nut, the

25 main body of the screw shaft being unthreaded and dimensioned to provide radial clearance with the internal threads of the nut, said resilient portion being operable to resiliently yield radially inwardly to disengage said screw thread segment from driving

30 engagement with the internal threads of the nut and to allow relative non-driving movement therebetween when a driving force applied to one of said nut and said screw shaft is opposed by a predetermined resistance to responsive movement of the other of said nut and

35 said screw shaft.

This further feature of the present invention thus provides a simple construction wherein the screw shaft and ball nut are released from each other to prevent damage when a position corresponding to a limit of the available mirror adjustment is reached. In such an event the resilient wall portions deflect radially inwardly of the screw shaft to disengage the threads on the screw shaft and ball nut.

The present invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a partially exploded perspective view of the motor housing, with a portion of the housing being broken away to reveal one of the two drive systems and with a portion of the other drive system being shown in exploded form.

Figure 2 is a front view of the motor housing shown with the mirror housing outlined in phantom and showing the two pivot axes of the mirror assembly.

Figure 3 is a sectional view through the assembled pinion gear, nut and screw.

Figure 4 is a sectional view similar to figure 3, but illustrating only the pinion gear.

Figure 5 is a sectional fragmentary view of the screw, viewed in the direction of arrows 5-5 of figure 3.

Referring first to Figures 1 and 2 of the drawings, there is illustrated the motor housing 10 which contains a pair of identical motors 11 and associated drive assemblies, only one of such motors being illustrated in simplified form in Figure 1. In Figure 2, the silhouetted outline of motor housing 10 is shown within the outline of the mirror housing 12 shown in phantom. Each of the motors drives an actuator screw 14, one of which causes movement of the

mirror about horizontal pivot axis 16 and the other of which causes pivotal movement of the mirror about vertical pivot axis 18 as a result of the connection of such screws to the mirror at actuator connection points 20 and 22. The intersection of axes 16 and 18 represents the point of universal attachment of the mirror to the unillustrated pedestal or base upon which the mirror is conventionally mounted.

As shown in Figures 1 and 3, each of the drive systems comprises a motor-driven worm gear 14 which engages the periphery of pinion gear 26. The other components of the drive system comprise a ball-shaped drive nut 28, which co-operates with actuator screw 14, and a wave washer 30 which provides a resilient thrust bearing surface between one end of pinion gear 26 and the interior of motor housing 10 which prevents excess axial play and vibration. The upper end of the actuator screw 14 protrudes through an opening in motor housing 10.

As best shown in Figures 3 and 4, the exterior periphery of pinion gear 26 is provided with pinion teeth 32 for driving engagement with worm gear 24. The interior of pinion gear 26 has a spherical socket surface 34 which snugly receives the ball-shaped exterior surface 36 of drive nut 28, while permitting pivotal sliding movement therebetween. A retention lip 38 on one axial end of spherical socket 34 resiliently yields outwardly to permit the drive nut to be snapped into place in the direction from top to bottom as viewed in Figure 4, thereby releasably retaining the drive nut within the pinion gear.

The interior of pinion gear 26 is further provided with a pair of diametrically opposite longitudinally extending driving splines 40 which co-operate with external grooves 42 in the spherical surface 36 of

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drive nut 28 (see Figure 1). The ends of grooves 42 are widened or flared to permit the ball to pivot relative to pinion gear 26 about each of the two axes mutually perpendicular to the longitudinal axis of the pinion gear.

Drive nut 28 has a threaded bore 44 which is dimensioned to provide radial clearance with the unthreaded shaft portion 46 of actuator screw 14. The tip of actuator screw 14 is provided with a ball 48 and transverse pins 50 which, in conventional fashion, establish a non-rotatable connection between actuator screw 14 and a slotted socket in the unillustrated back of the mirror.

Actuator screw 14 has a square bore 52 (Fig. 5) extending along a portion of its length, and diametrically opposite sides of shaft portion 46 have a pair of U-shaped slots 54 extending from the outer surface to bore 52 to define a pair of fingers 56 which are resiliently yieldable in the radial direction relative to the main body of shaft portion 46. The free ends of fingers 56 have an outwardly extending pair of thread segments 58 (see Figure 5) dimensioned to normally engage the internal threads of bore 44 of nut 28. A hairpin-shaped spring 60 is received within bore 52 of screw 14. The legs of spring 60 normally maintain threaded fingers 56 in their thread-engaging position shown in Figure 5, but permit the fingers to yield resiliently inwardly to disengage the threads in an override or overload condition. Tips 62 of spring 60 are received in slots 64 of screw 14 to anchor the spring in position and to limit the radially outward movement of the legs of the spring and of fingers 56, thereby limiting the outward engagement forces on the thread elements.



In operation, selective actuation of one of the motors, by conventional means not forming a portion of this invention, causes rotation of the associated worm gear 24 which in turn causes pinion gear 26 and drive nut 28 to rotate. Rotation of drive nut 28 causes axial movement of actuator screw 14, because pins 50 of the screw are engaged in slots in the back of the mirror to prevent the screw from rotating. Such axial movement causes the mirror to pivot about one of its two axes of pivotal freedom, i.e., axis 16 or axis 18 of Figure 2. As the mirror pivots and its point of connection to tip 48 of actuator screw 14 travels along an arc, the ball and socket portions of pinion gear 26 and drive nut 28 permit the axis of actuator screw 14 to pivot to follow such arc of movement, thereby assuring a smooth and continuous driving relationship throughout the travel of the mirror.

In the event that the motor-controlling switch continues to provide current to the motor after the mirror has reached the limit of its travel, continued rotation of drive nut 28 after screw shaft 14 can no longer move longitudinally will cause the internal threads of the drive nut to resiliently force threaded fingers 56 of actuator screw 14 to yield inwardly against the outward bias of spring 60, thereby permitting such continued rotation of motor 11, pinion gear 26 and drive nut 28 without damage to any of the components. Similarly, in the event that the mirror is manually repositioned, while motor 11 is inoperative, the resulting axial movement of actuator screw 14 relative to the non-rotating drive nut 28 will similarly cause threaded fingers 56 to resiliently yield in a radially inward direction to disengage the threads and accommodate such relative movement.

In the preferred embodiment, the housing, worm gear and actuator screw are made of duPont Delrin 500, while the pinion gear and drive nut are made of duPont 801 nylon. The interference between retention lip 38 and the diameter of drive nut 28 is .008 inches, while the interferences at the other end of socket 34 is .080 inches. The diameter of the spherical surface of the ball nut is .514 inches and that of the spherical socket is .518 inches.

10 This invention may be further developed within the scope of the following claims. Accordingly, the above specification is to be interpreted as illustrative of only a single operative embodiment of the present invention, rather than a strictly limited sense.

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CLAIMS

1. A drive system for use as a remote control system for a vehicle mirror mounted for pivotal movement relative to a base, comprising electric motor means (11) secured to the base (10) and having a worm gear (24) on its output shaft which engages an externally threaded pinion gear (26) rotatably mounted on the base (10), and wherein the pinion gear (26,28) is also provided with internal threads (44) to serve as a nut (26,28), the rotation of which by the worm gear (24) causes a non-rotatable mirror-engaging screw shaft (14) in threaded engagement with the internal threads (44) of the nut, to move axially to reposition the mirror, characterised in that the pinion (26) and nut (28) are formed as two separate but concentrically connected elements, the first of said elements (26) being in the form of an annulus having external pinion gear teeth (32) adapted to be rotatably driven about a first axis by the motor-driven worm gear (24), said annulus having a spherical socket surface (34) on the interior of the annulus, the second of said elements (28) being in the form of a second annulus having a ball-shaped surface (36) on its exterior circumference dimensioned to be snugly but rotatably received in and retained by said spherical socket surface (34), and said second element (28) having internal threads (44) on the interior of said second annulus for driving engagement with a screw shaft (14), driving formations (40,42) on said first and second elements (26,28) for causing the rotation of said first element (26) by the worm gear (24) to produce concurrent rotation of said second element (28) about said first axis, said spherical surfaces (34,36) and said driving formations (40,42) permitting relative pivotal movement between said first and

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second elements (26,28) about the two mutually perpendicular axes (16,18) which are perpendicular to said first axis; whereby, in use, actuation of the motor (11) produces mirror position-adjusting longitudinal movement of the screw shaft (14), while said spherical surfaces (34,36) permit the axis of the screw shaft (14) to pivot in response to movement of the screw shaft-to-mirror engagement point transverse to the screw shaft axis in response to pivotal movement of the mirror.

2. A drive system as claimed in claim 1, wherein said driving formations (40,42) comprise splines (40) arranged parallel to said first axis, and grooves (42) which are wider at their ends than in their intermediate portions, to permit the axes of said pinion (26) and nut (28) to be skewed relative to each other.

3. A drive system as claimed in claim 1, wherein a slight interference fit between the greatest diameter of said ball-shaped surface (36) and the receiving opening for the second element (28), at one end of the annular spherical socket (34) within said first element (26), requires an axial force to snap together said elements (26,28), said spherical socket (34) thereafter retaining said elements (26,28) together.

4. A drive system as claimed in claim 1, wherein the screw shaft (14) is provided with radially flexible teeth (56), capable of resiliently yielding in a radially inward direction to disengage from said internal nut threads (44) when a driving force applied to one of said nut (28) and said screw shaft (14) is opposed by a predetermined resistance to responsive movement of the other of said nut (28) and said screw shaft (14).

5. A drive system for use in a remote control system for a vehicle mirror mounted for pivotal movement relative to a base, comprising electric motor means (11) secured to the base (10) and having a worm gear (24) on its output shaft which engages an externally threaded pinion gear (26) rotatably mounted on the base (10), and wherein the pinion gear (26) is also provided with internal threads (44) to serve as a nut, the rotation of which by the worm gear (24) causes a non-rotatable-engaging screw shaft (14) in threaded engagement with the internal threads (44) of the nut to move axially to reposition the mirror, characterised in that the screw shaft (14) has a longitudinal bore (52) for at least a portion of its length thereby to create a tubular shaft wall, a portion (56) of said tubular wall being partially detached from the main body (46) thereof so as to be capable of resiliently yielding radially inwardly into said shaft bore (52), the radially outer face of said resilient portion (56) being provided with a segment of a screw thread (58) which, in the normal position of said resilient portion (56), projects radially outwardly from the outer surface of said tubular wall for driving engagement with the internal threads (44) of the nut (28), the main body (46) of the screw shaft (14) being unthreaded and dimensioned to provide radial clearance with the internal threads ((44) of the nut (28), said resilient portion (56) being operable to resiliently yield radially inwardly to disengage said screw thread segment (58) from driving engagement with the internal threads (44) of the nut (28) and to allow relative non-driving movement therebetween when a driving force applied to one of said nut (28) and said screw shaft (14) is opposed by a predetermined resistance to responsive movement of the other of said nut (28) and said screw shaft (14).

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6. A drive system as claimed in claim 5, wherein spring means (60) in said screw shaft bore (52) engage and resiliently bias said resilient portion (56) in a radially outward direction.

5        7. A drive system as claimed in claim 5, wherein  
said resilient portion (56) comprises at least two  
angularly spaced longitudinally extending fingers (56),  
one end of each finger (56) being integrally connected  
to the main body (46) of the screw shaft (14) and the  
10      other end of said fingers (56) having said screw  
thread segment (58) integrally formed around, said  
fingers (56) being angularly separated from each other  
by portions of the main body (46) of said screw shaft  
(14).

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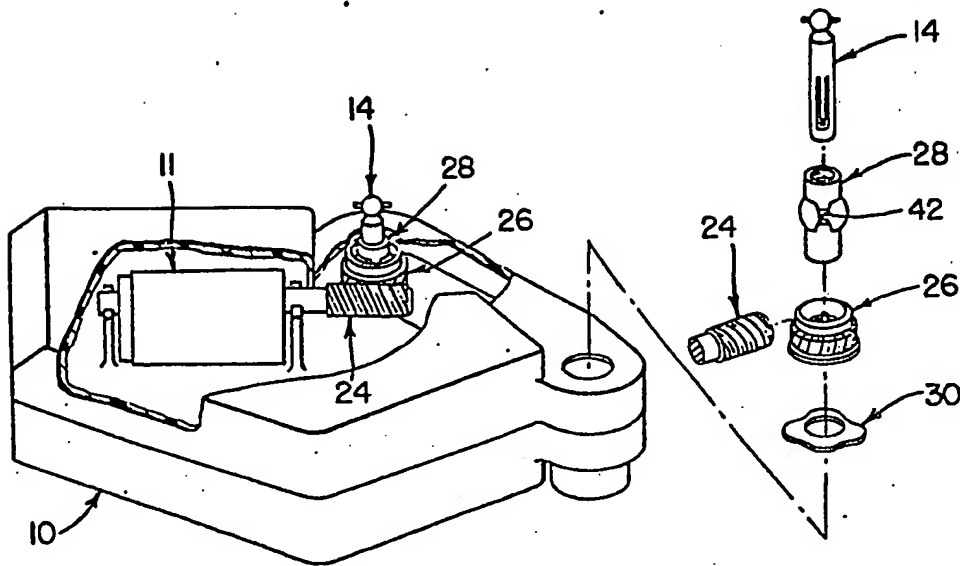


FIG. 1

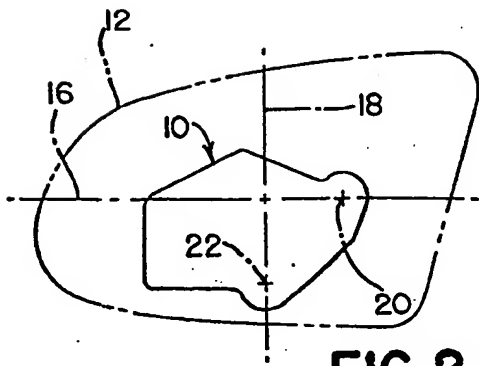


FIG. 2

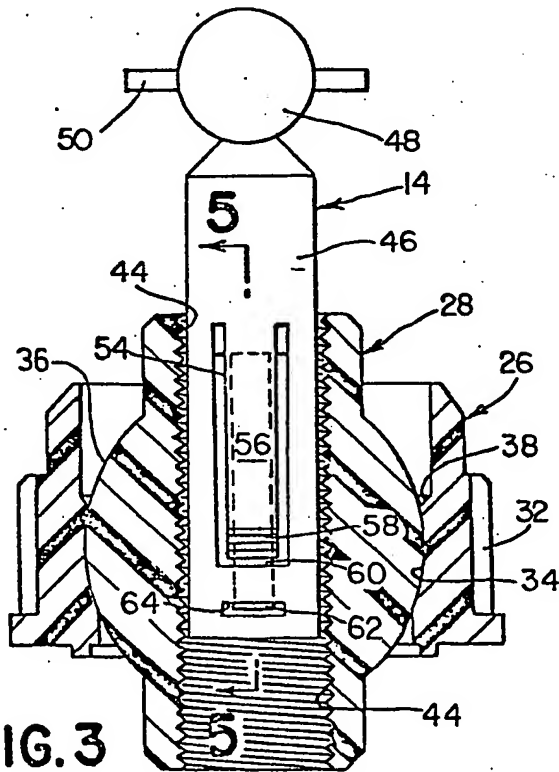


FIG. 3

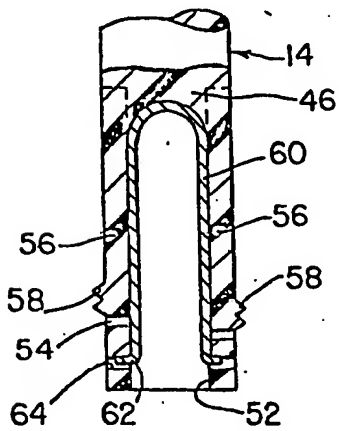


FIG. 5

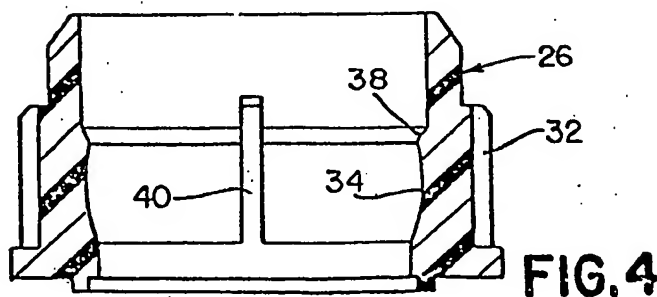


FIG. 4



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
Y	DE-A-2 840 789 (WEISS) * Page 15, last paragraph; page 13, line 14 - page 14, line 1; figures 4,9 *	1	B 60 R 1/06
A	* Page 12, line 11 - page 13, line 13; figures 4,5 *	5-7	
A	* Page 12, line 11 - page 13, line 13; figures 4,5 *	4	
Y	US-A-4 202 603 (MIYAUCHI) * Column 5, line 61 - column 6, line 23; figure 7 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
P,Y	EP-A-0 094 856 (MANZONI) * Claim 1; figure 4 *	1	B 60 R 1/06 F 16 D 3/18
A	US-A-3 054 275 (ONGARO) * Column 2, lines 59-68; figure 2 *	2	
D,A	GB-A-2 032 367 (MURAKAMI KAIMEIDO) * Page 2, lines 31-71; page 3, lines 123-128; figures 12,14 *	1,4,5,7	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 14-02-1984	Examiner OSBORNE J.
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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DOCUMENTS CONSIDERED TO BE RELEVANT			Page 2
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 7)
A	EP-A-0 059 073 (MURAKAMI KAIMEIDO) * Page 8, line 30 - page 9, line 28; page 12, lines 26-35; figures 8, 10 *  -----	1, 4, 5, 7	
			TECHNICAL FIELDS SEARCHED (Int. Cl. 7)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 14-02-1984	Examiner OSBORNE J.
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons  & : member of the same patent family, corresponding document	